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MAY 1983

INVESTIGATION OF SOIL AND WATER CONTAMINATION AT WESTERN PROCESSING INC., KING CO., WA

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MAY 1983

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ACKNOWLEDGEMENTS

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1.0 SUMMARY

Western Processing, Inc., Kent, Washington, which purports to be an industrial waste recycling facility, was suspected of having contaminated soil, groundwater and surface water on and around its 13-acre site.

During October 1982 a series of 32 on-site holes and six offsite holes from 15 to 30 feet deep were dug at 30 locations in order to sample the soil and to install wells and well points. Eleven samples of surface soil and seven hand augered samples of soil from a berm on the east edge of the site were also taken. In all, 130 soil samples were taken and 35 groundwater samples were obtained from the wells and well points. Additionally, the water used to wash down personnel, vehicles and equipment coming off the site was sampled. All samples were analyzed for a wide variety of organic chemicals and metals, and groundwater was checked for acidity and alkalinity.

Significant levels of many toxic substances were found in a high proportion of the soil and groundwater samples; these included 21 known carcinogens and 28 suspected carcinogens. Off site wells indicate that some of these toxic substances have migrated across the site boundaries. Contamination in the groundwater extends down to at least 30 feet from ground surface and out to at least 200 feet north of the site boundary. Groundwater levels under the site imply that contaminated groundwater will move offsite in all directions.

At least 19 of the soil samples and six of the groundwater samples were defined as hazardous waste by the standards of the Resource Conservation and Recovery Act (RCRA) by reason of their content of soluble toxic metal. In one well the groundwater was so alkaline that it was a RCRA hazardous waste by reason of its corrosivity. The used wash water collected after decontamination of vehicles, personnel and equipment, contained high levels of lead and other toxic substances.

2.0 INTRODUCTION

Western Processing began operations in 1957 as an animal by-products and brewer's yeast processor. Since then the operation expanded to include the handling of solvents, flue dust, battery chips, acids, cyanides and a wide variety of industrial waste. The company has Interim Status as a storage facility for hazardous materials as regulated by the Resource Conservation and Recovery Act (RCRA). It has no state or local permits for discharge to a sewer, to surface water or to the ground and groundwater.

The facility occupies about 13 acres on which there is a small laboratory, a solvent recycling plant, a fertilizer plant, bulk storage tanks, drum storage areas, piles of flue dust, construction debris, and large cement-block above ground storage lagoons for liquid wastes, cooling water and process water. Mill Creek, also known as King County Drainage Ditch #1, runs across the northwest corner of the site from south to north. Along the eastern boundary the Kent Bicycle Trail occupies a former railroad right-of-way, along which runs a high voltage power line and a drainage ditch. Beyond these to the east is the Burlington Northern Railroad. Access is from South 196th Street along the northern boundary.

The site is located within the City of Kent but about four miles north of the central business district. It lies in Section 1, Township 22N Range 4E, Willamette Meridian, the entrance is at latitude 47°25'37"N, longitude 122°14'31"W, and the address is 7215 South 196th Street (see Fig. 1).

The site lies in the flood plain of the Duwamish/Green River. The area is very flat, with an average elevation around 20 feet above mean sea level.

During May 1982 the U.S. Environmental Protection Agency (EPA) conducted a stream survey around Western Processing Inc. (EPA 1982). Twenty-six of the priority pollutants (Appendix C) were found in the surface waters around the site, all of which were subsequently found on-site.

During June 1982 the Municipality of Metropolitan Seattle, (METRO), sampled surface water upstream and downstream of Western Processing in Mill Creek. A marked increase in heavy metal content, mostly zinc, was noted.

As a result of these findings and an on-site inspection, the EPA issued an order under Section 3013 of the Resource Conservation and Recovery Act (RCRA), to require the owner to conduct such monitoring as would be reasonable to acertain the nature and extent of hazard to human health or the environment presented by the site. After the site owner had declared himself unable to carry out the necessary monitoring, a court order was obtained to enable the EPA and its contractors to investigate the site.

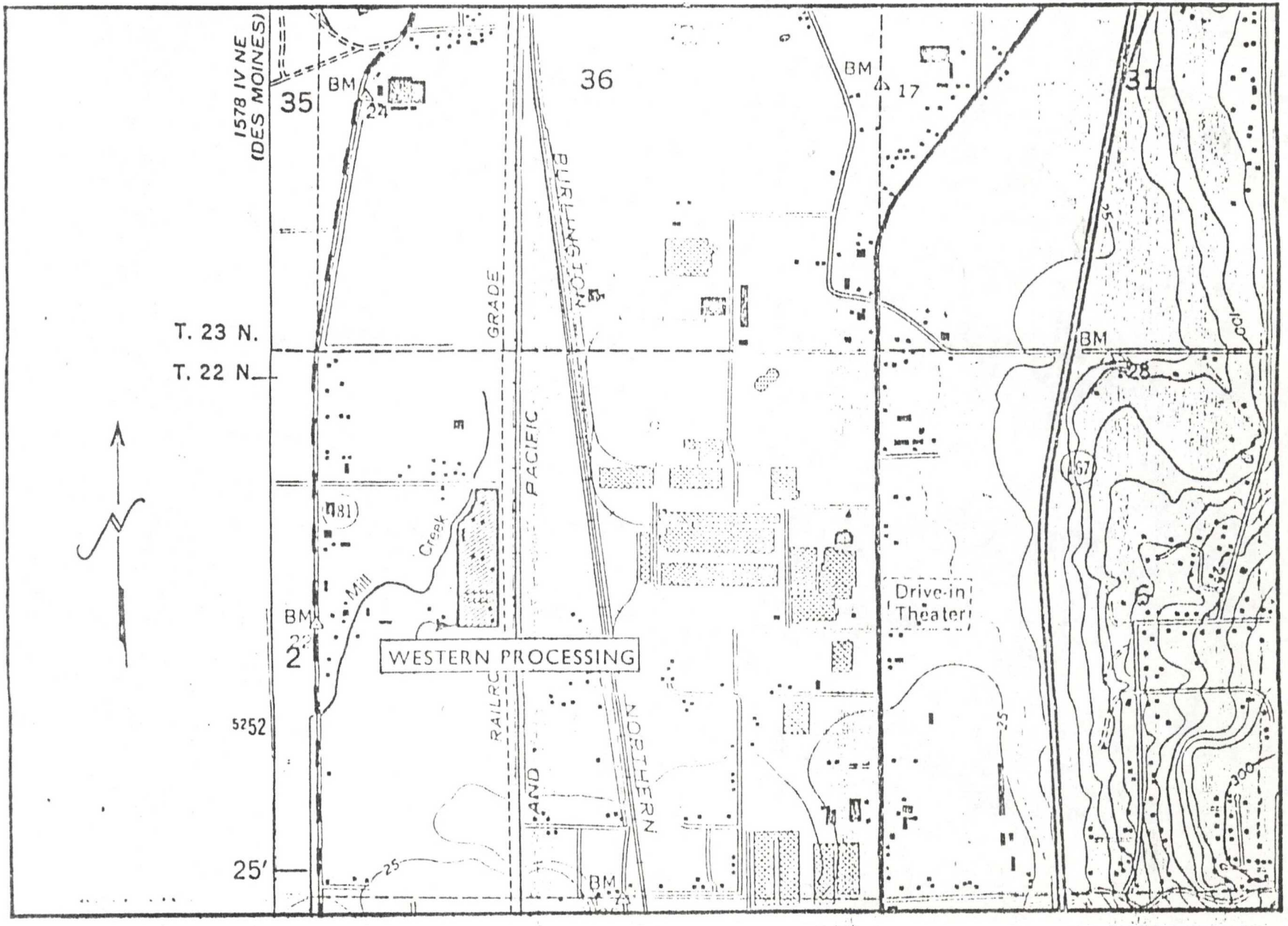
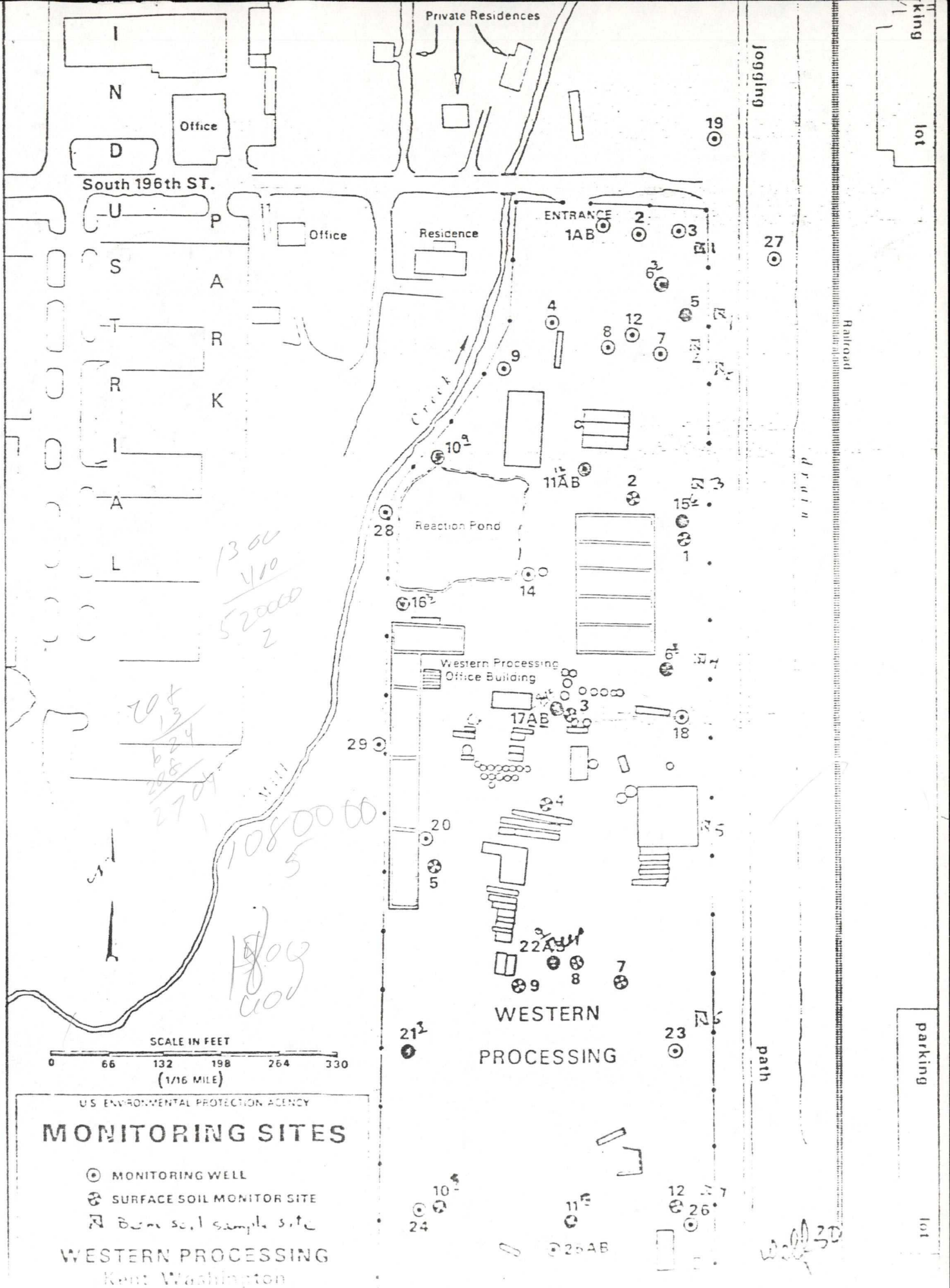


Figure 1

WESTERN PROCESSING
Kent, Washington

Sampling sites were proposed on the basis of the known site history and from review of archival imagery, that is, aerial photographs dating from 1960 through 1980. A number of wells were simply installed around the perimeter, and a line of double completion wells (Stations 1, 11, 17, 22), were put in a line down the center of the site to investigate changes in hydraulic head with depth. Remaining locations were selected as being on the site of former lagoons, waste piles, spills, etc., or between such sites and the probable receiving waters to north, west and east of the site (see Fig. 2).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parking
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Creek
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Western Processing
Office Building
WESTERN
PROCESSING
SCALE IN FEET
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(1/16 MILE)
U.S. ENVIRONMENTAL PROTECTION AGENCY
MONITORING SITES
MONITORING WELL
SURFACE SOIL MONITOR SITE
Burn soil sample site
WESTERN PROCESSING
Kent Washington

3.0 GEOLOGY AND HYDROLOGY

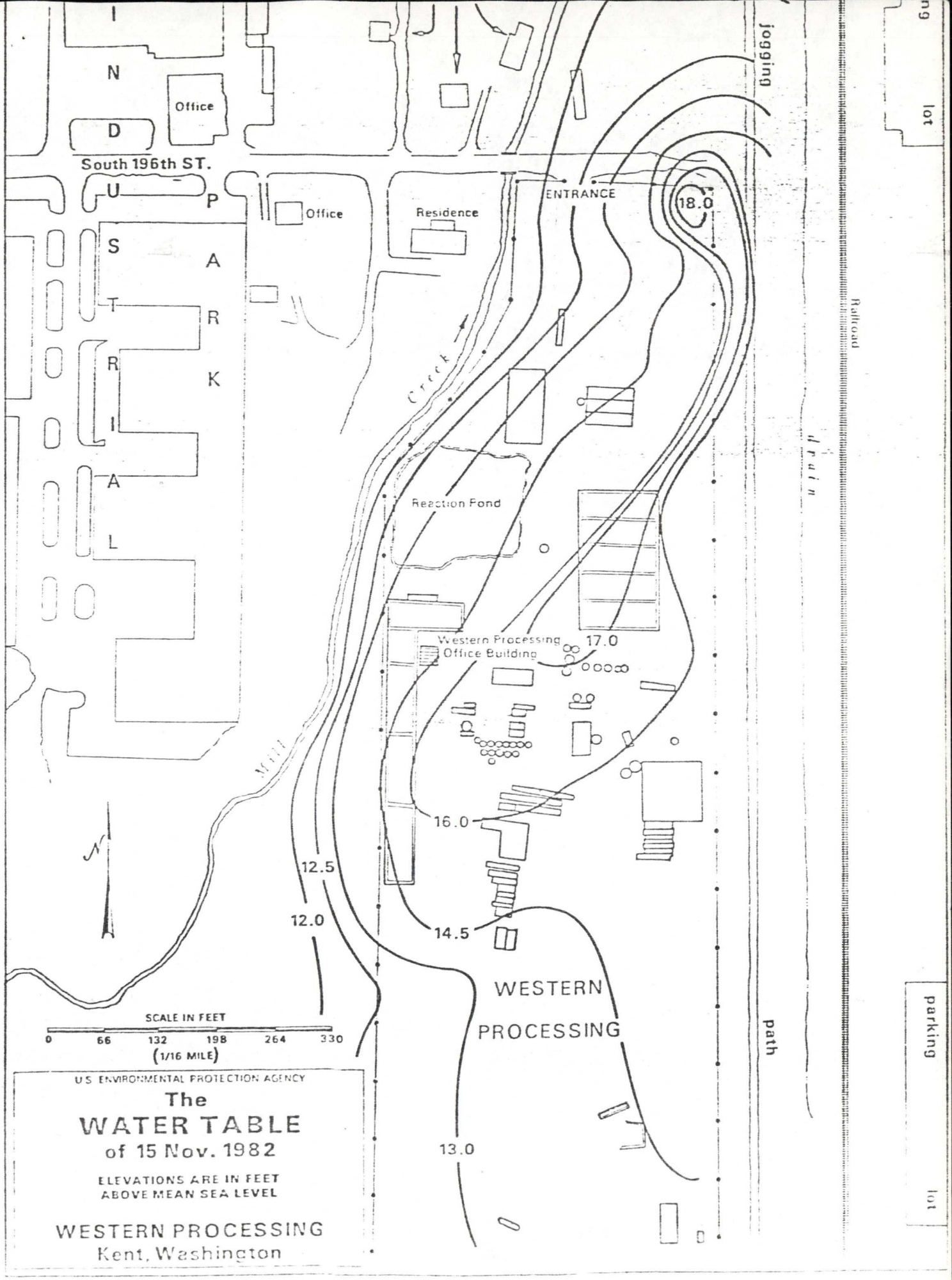
The Green River valley lies within the Puget Sound Lowland which consists of a broad plain of glacial sediments cut into by a network of marine embayments. The Green River valley was formerly one of those embayments and is filled with sand, gravel, silt and clay brought down by the White, Green, Black and Cedar Rivers (Mullineaux, 1970).

During the course of the investigation, the Western Processing site itself was found to be underlain by sand, silt, gravel, clay, peat and artificial fill. In places as much as six to eight feet of fill were recorded and in Well 22B battery casings were reported mixed with silty sand from 15 to 24 feet. Clay was encountered in a number of boreholes at depths from 6-15 feet, being more common under the northern part of the site, at Wells 1A, 2, 4, 5, 6, 7, 8, 9, 10, 11A, 12, 14, 17, and 20, but absent at Wells 18, 22B, 23, 24, and 25B (see Fig. 2 and Appendix A). The clay is gray to bluish gray in color and contains organic material. It was probably laid down in a lake, or lakes, which were common in the Green River valley (Mullineaux, 1970), and varies in thickness from one to four feet. The commonest materials encountered in boreholes were fine sand, light brown or grayish brown, and silt, gray to grayish brown, often mixed with some clay.

The water table was found at very shallow depths, ranging from 3 to 12 feet and averaging 6 feet from the surface. At Well 19, which was installed in a depression north of S. 196th Street the water flowed out at the surface. Water level measurements taken on November 15, 1982 (Table 1) suggest that the relatively permeable material at the surface within the facility and the lack of vegetation have resulted in a higher rate of percolation of rain into the ground than in surrounding areas. This appears to have created a groundwater "high" or mound under Western Processing (see Fig. 3). Although the predominant flow directions of groundwater are west and north to Mill Creek, the mound would cause flow to the east and even south for a short distance as well. The flow at Well 19 is probably a response to this local increase in hydraulic head under a confining clay layer.

There are higher hydraulic heads in the shallow wells of adjacent pairs such as 11A, 11B and 17A, 17B (Table 1). This indicates that the groundwater mound has created a hydraulic head which is driving groundwater down into the aquifer at least to levels below 30 feet, since flow is always from higher hydraulic head to lower.

A berm along the east side of Western Processing now mostly prevents surface runoff in that direction. Surface runoff from the site was observed during the site investigation going west to Mill Creek or out of the front gate and down into a depression outside the north east corner of the site.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Western Processing
Office Building
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16.0
12.5
12.0
14.5
13.0
WESTERN
PROCESSING
joggling
path
Railroad
parking
lot
SCALE IN FEET
0 66 132 198 264 330
(1/16 MILE)
U.S. ENVIRONMENTAL PROTECTION AGENCY
The
WATER TABLE
of 15 Nov. 1982
ELEVATIONS ARE IN FEET
ABOVE MEAN SEA LEVEL
WESTERN PROCESSING
Kent, Washington

Table 1

WATER TABLE ELEVATIONS
NOVEMBER 15, 1982

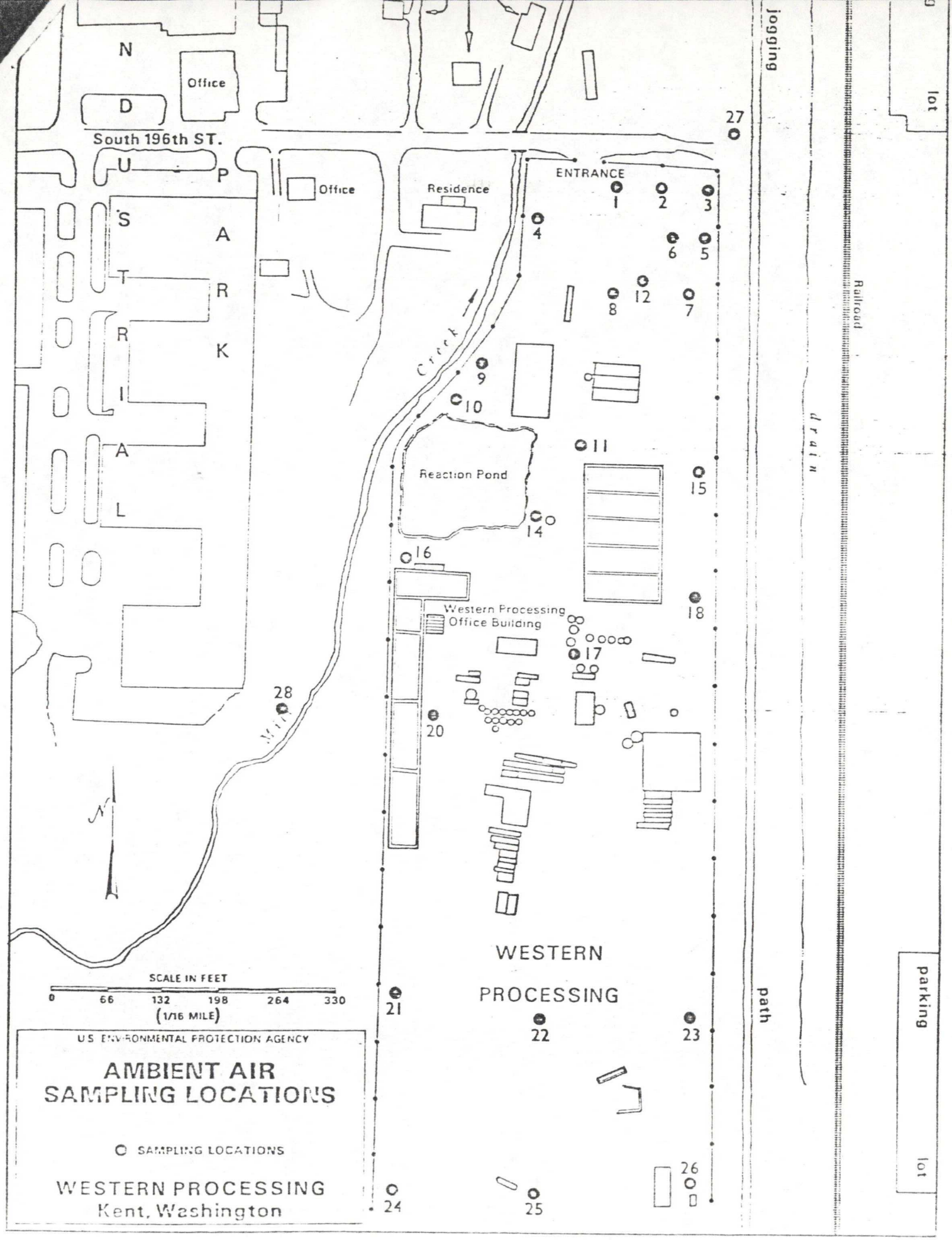
Observation Well Number	Water Table Elevation (Ft. above mean sea level)
1A (shallow)	13.55
1B (deep)	12.86
2	14.37
3	18.35
4	12.37
5	15.17
6	14.19
7	14.59
8	13.39
9	11.35
10	12.09
11A (shallow)	14.83
11B (deep)	12.94
12	14.10
13	11.91
14	Cap rusted on
15	15.29
16	13.73
17A (shallow)	16.39
17B (deep)	12.74
18	15.86
19	14.35
20	15.88
21	12.80
22A (shallow)	13.90
22B (deep)	13.77
23	14.05
24	13.34
25A (shallow)	13.81
25B (deep)	13.85
26	14.48
27	14.51

4.0 PRELIMINARY SITE INVESTIGATION AND SITE SAFETY

The toxic nature of many of the materials handled by Western Processing required the development of a safety plan prior to any on-site work. An ambient air characterization of the site was performed on September 23, and September 27, 1982, to determine what respiratory hazards might be present.

On September 23, the field team members entered the site wearing self contained breathing apparatus and measured the air quality at 26 sites (see Fig. 4), using a Century Systems Organic Vapor Analyzer (OVA), Model 128, and a Photoionizer, HNU Model PI 101. Station 17 showed 4-5 ppm, the only site above a background level of 1 ppm. Shallow holes were dug by hand at a number of locations to see if disturbed soil released volatile organics. Stations 3, 11, 17 and 20 showed relatively high levels of organics, so soil samples were taken from these locations to determine what substances were present. The soil samples from Stations 17 and 20 showed detectible but not quantifiable levels of several volatile organic solvents.

On September 27, the field team returned to the site to install High Vol samplers with activated charcoal tubes. Four were installed on-site at Stations 3, 11, 17 and 20 and two off-site at Stations 27 and 29 in an attempt to collect organic vapor from the normal breathing zone. Sampling was for a period of four hours only. None of these tubes showed detectible levels of organics when analyzed at the laboratory of Ecology and Environment, Inc., Buffalo, New York. On the basis of the soils data, and because of the presence of barrels and tanks of waste on-site, it was decided that all personnel would wear air purifying respirators with combination particulate and organic vapor cartridges when working on site. As part of the safety precautions it was required that the breathing zone around any hole being dug by drill or backhoe be monitored at all times with the OVA or photoionizer. All personnel leaving the site were decontaminated with steam cleaner and detergent solution (see Fig. 5). All equipment entering or leaving the site was steam cleaned. Wash water from these decontamination operations were collected into 55-gallon Department of Transporation approved drums. After analysis they were removed to an approved waste disposal site.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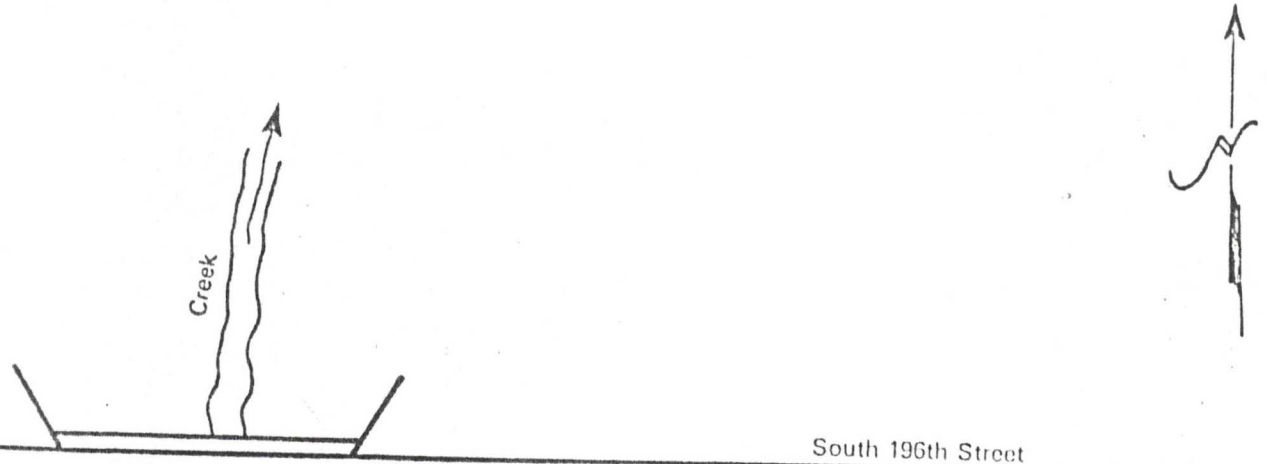
Creek
Reaction Pond
Western Processing
Office Building
Main
WESTERN
PROCESSING
SCALE IN FEET
0 66 132 198 264 330
(1/16 MILE)
U.S. ENVIRONMENTAL PROTECTION AGENCY
AMBIENT AIR
SAMPLING LOCATIONS
SAMPLING LOCATIONS
WESTERN PROCESSING
Kent, Washington
jogging
path
Railroad
drain
lot
parking
lot

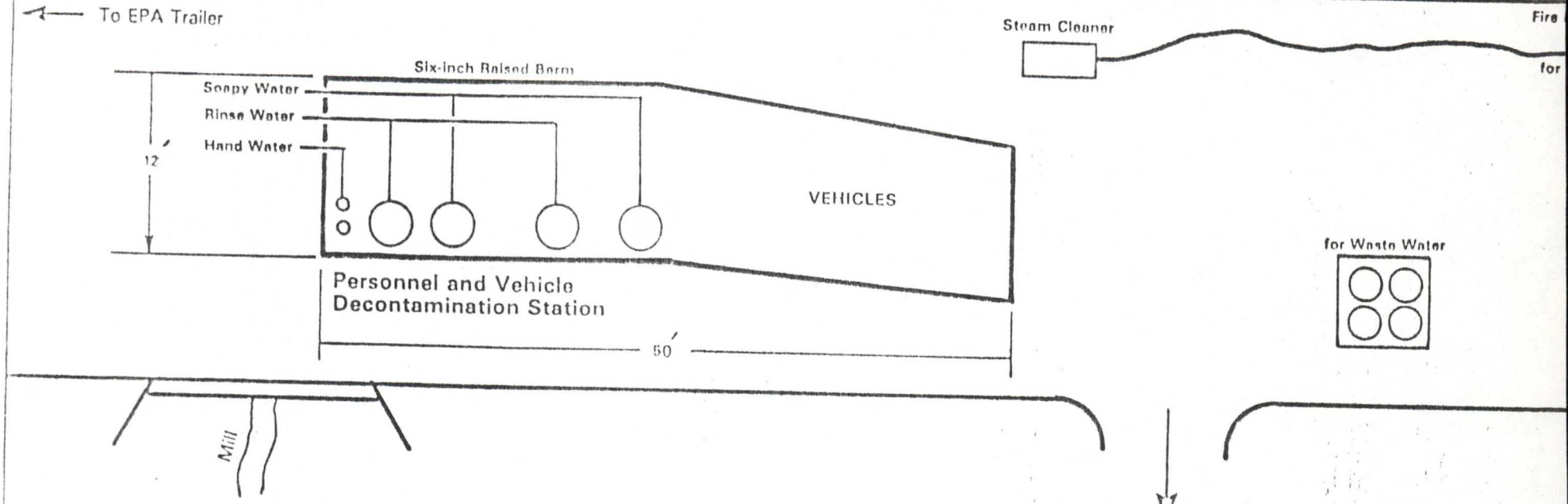
Figure 4

U.S. ENVIRONMENTAL PROTECTION AGENCY

PERSONNEL AND VEHIC DECONTAMINATION STATION

WESTERN PROCESSING
Kent, Washington





WESTERN PROCESSING COMPANY, INC.

*NOTE: Drawing not to scale—for illustration/orientation purposes only.

5.0 SAMPLING PROGRAM

5.1 Well Installation and Soil Sampling

The EPA was initially informed that the site had been raised with demolition debris and that they must be prepared to find concrete, brick, reinforcing bars, etc. below the surface. It was proposed, therefore, to use a backhoe to dig through the fill, an excavation method that could handle such material and also expose the depth and type of fill. Holes deeper than the reach of the backhoe were to be drilled with a cable tool rig. The first two holes, at Wells 1 and at Well 11, were dug with the backhoe but exposed no demolition debris. Instead, sand and silt were common.

At Station 11 the level of volatile organics in the air around the backhoe pit was measured at greater than 1000 ppm. For this reason and because the site owner claimed that the backhoe pits were creating a hazard for his employees, it was decided to sample soil and install wells with the cable tool only. Later it was decided to bring a soil sampling drill rig on-site to sample soil with a small diameter (3") solid stem auger, and to install well points in the holes.

The initial holes were dug and wells installed in the first week of October. The soil sampling rig was brought on-site October 12. On-site drilling was completed by October 26. Because of the methods used, none of the soil samples is of undisturbed material. Contamination from levels other than that being excavated was minimized by carefully cleaning up the hole before sampling, in the case of the backhoe and auger, and by driving down steel casing behind the bit to shut off the upper part of the hole in the case of the cable tool rig. Samples taken with the cable tool from below the water table were scraped off the bit. For a summary of soil samples taken from well locations see Table 2. Each soil sample was collected into two 8-oz. wide mouth glass jars with teflon-lined lids. The soil was scooped with a gloved hand into the bottles. Between each sampling an outer disposable vinyl glove was discarded and an inner butyl rubber glove washed in clean water, brought onto the site by the field team.

Nine samples were also collected with a hand auger, on October 25, along the east side of the site. Seven came from between one and two feet below the surface of a berm of material scraped off Western Processing's yard and heaped up along its east side to prevent run-off into a ditch outside the east fence. The remaining two samples came from within the ditch at the north end of the site where a pipe protrudes through the berm and boundary fence and where the material in the ditch is stained as if by spilled material (see Fig. 2). These were handled in the same manner as the other soil samples.

Eleven samples of surface soil were collected November 18, from what appeared to be spill sites (see Fig. 2). These were scraped up with the sample container and pushed into the bottle with the teflon-lined lid. The outside of all sample containers were washed before being packed.

Soil TABLE 2.

SUMMARY OF ~~CORE~~ SAMPLING Locations
WESTERN PROCESSING COMPANY, INC.

Well Number	Method of Drilling	Method of Sampling	Depth to ~~Bottom~~ SCREEN (ft.)	Depths at which samples were collected (ft.) 3	6	9	12	15	18	21	24	27	30
1A	backhoe	backhoe	12	x	x	x	x						
1B	cable tool	----	30										
2	auger	auger	12	x	x	x	x	x					
3	auger	auger	12	x	x	x							
4	auger	auger	15	x	x	x							
5	auger	auger	12	x	x	x	x						
6	auger	auger	12	x	x	x	x						
7	auger	auger	12	x	x	x							
8	cable tool	auger	16	x	x	x							
9	auger	auger	15	x	x	x	x						
10	auger	auger	15	x	x	x	x	x					
11A	backhoe	backhoe	12	x	x	x*	x						
11B	cable tool	----	29										
12	auger	auger	11	x	x	x	x	x					
13	auger	auger	9	x	x	x							
14	auger	auger	15	x	x	x	x	x					
15	cable tool	auger	16	x	x	x							
16	auger	auger	15	x	x	x	x	x					
17A	cable tool	cable tool	15	x	x	x	x	x	x	x	x	x	x
17B	cable tool	cable tool	30										
18	cable tool	auger	16	x	x	x							
19	auger	auger	6	x	x	x	x						
20	auger	auger	15	x	x	x	x	x					
21	auger	auger	15	x	x	x	x	x					
22A	cable tool	cable tool	15	x	x	x	x	x					
22B	cable tool	----	27										
23	cable tool	auger	15	x	x	x							
24	auger	auger	15	x	x	x	x	x					
25A	cable tool	auger	16	x	x	x							
25B	cable tool	----	26										
26	cable tool	auger	16	x	x	x							
27	auger	auger		x	x								
28	auger	auger	12	x	x	x							
29	auger	auger	12	x	x	x							
30	auger	auger	12										

* Samples collected at 8 ft. and 10 ft.

--- ~~Sample collected by auger adjacent to cable tool~~ ~~with~~ no sample collected, since soils were documented in adjacent hole.

Backhoe and cable tool holes had 4-inch PVC casing and slotted screen set in them, the screen was surrounded with gravel pack of pea gravel and a mixture of bentonite and sand placed around the casing to provide a seal up to the surface (see Appendix A). The 3-inch holes drilled with the solid stem auger had stainless steel well points on 2-inch black iron pipe driven down into them. Both wells and well points then had a 6-inch steel casing cemented in around the top of the well and capped with a padlocked steel cap. All wells were surged and bailed or pumped to yield relatively sediment free water as part of well completion. The depth from which water samples were taken depends, of course, on the depth at which the well screen is set (see Appendix A).

5.2 Groundwater Sampling

After all monitoring wells had been installed and water levels measured, all of them were pumped with a Robb Air Pump until either three times the volume of water standing in the casing had been discharged or the well was dry. The first three wells pumped, Nos. 2, 13, and 19 were pumped onto the ground. Later the water pumped from wells was collected into drums and stored with the wash water from the decontamination station. To reduce cross contamination to a minimum the pump and its discharge line were submerged in potable water from the City of Kent fire hydrant and run for five minutes between each well.

Each well was allowed to recharge and then sampled with a stainless steel bailer which had been washed with distilled water and rinsed first with reagent grade acetone and then with pure methanol. The bailer was then allowed to dry. The bailer was lowered into each well on a monofilament line. A new line was used for each well. On-site wells were sampled from November 1, 1982 to November 12, 1982. Off-site wells were sampled on November 15, 1982.

The bailer's and sampler's gloves were rinsed twice with the water being sampled and then the sample containers were rinsed. Each prelabeled container was then filled and its outside washed off with potable water before it was placed in an ice chest. Two half-gallon brown glass bottles with teflon-lined lids were collected for extractible organics analyses, two 40-ml glass vials with teflon-lined lids for volatile organics and two 1000-ml polyethylene containers for heavy metals and for cyanide analyses. An additional 500-ml polyethylene container was filled to be checked for total dissolved solids and chloride. At the time of sampling the conductivity and pH of the water was checked (see Appendix B).

5.3 Wash Water and Waste Water Samples

Water used at the decontamination station and from well pumping was collected into recycled steel drums as noted above. At the end of each week a composite sample of water was taken with new glass tubing. Two 1/2gallon brown glass bottles with teflon-lined lids and two 1000-ml polyethylene containers with teflon-lined lids were filled.

5.4 Analyses Requested

All but the total dissolved solids/chloride samples from groundwater and wash water/waste water samples were sent to contract laboratories. California Analytical Laboratories, Sacramento, California, analyzed inorganics samples, and Mead CompuChem, Research Triangle Park, North Carolina, analyzed organics. All soil and groundwater samples were analyzed for the heavy metals, acid extractible organics, base/neutral extractible organics and volatile organics on the priority pollutant list (see Appendix C).

All wash water/waste water samples were sent to the EPA Region X Laboratory in Manchester, Washington, to be analyzed for arsenic, mercury, cadmium, nickel, lead, zinc and for polychlorinated biphenyls (PCBs) and benzo[a]pyrene. These parameters were required by METRO as a precondition for discharge to the sanitary sewer. The water was found to be too highly contaminated for this, however.

For the organic priority pollutants the laboratory used analytical methods 601-613 (Federal Register, vol. 44, p. 34408, June 14, 1979). For the metals the laboratory used atomic adsorption (AA) spectroscopic or inductively coupled plasma optical emission spectroscopic methods (Federal Register, vol. 41, p. 52780, December 1, 1976). Levels of detection are established by the contract between EPA and the laboratories, (EPA contract 68-01-6608).

It should be noted that groundwater samples to be analyzed for inorganics by these standard methods are iced, and filtered at the laboratory before being analyzed. In this way only dissolved metals are measured. Groundwater for organics analysis is not filtered at the laboratory. Instead it is extracted with organic solvent, and the solvent extract is analyzed. This process will tend to strip any organics adsorbed on any sediments particles present. Filtering before extraction would particularly tend to remove non-polar compounds which adsorb on sediment.

5.5 Sample Documentation and Handling

Prior to sampling the field team obtained station numbers from the EPA data storage and retrieval computer system (STORET) (see Appendix D). The Sample Management Office of Viar and Co., Arlington, Virgina, assigned laboratories (see Section 5.4), and these assigned case numbers and laboratory numbers to the samples. The EPA Region X Laboratory also assigns laboratory numbers.

Sampling procedures at the site were documented in a field log book. All containers were labelled and tagged. Samples going to the contract laboratories were accompanied by an Organic Traffic Report form or Inorganic Traffic Report form, and a copy of the Chain of Custody Record. Samples going to the Region X Laboratory were accompanied by an Analyses Required form, a Field Data Sheet and a Chain of Custody form. A summary sample documentation is included in Appendix D.

All containers were sealed with fiber tape; the outsides of liquid filled bottles were marked with grease pencil to indicate the level of liquid originally in the bottle. Sample containers going to the contract laboratory were packed in vermiculite inside a 4-ml polyethylene bag. This bag in turn was packed in an outer bag containing ice. The bags were placed inside ice chests that were sealed with fiber tape and custody tape. Packaging met the requirements of the National Enforcement Investigation Center (NEIC, 1980). Sample containers going to the EPA Region X Laboratory were placed in ice in plastic bags and packed in cardboard boxes sealed with fiber tape and custody tape. Ice chests were shipped via Federal Express, Inc., other samples were shipped via Kitsap Delivery Service, Inc.

All samples remained in the custody of the Field Investigation Team (FIT) of Ecology and Environment, Inc., until delivered to the respective shippers.

5.6 Quality Assurance Program

All sample containers were prepared under contract to the EPA by Ecology and Environment, Inc., 195 Sugg Road, Buffalo, New York. As a check on the containers and field procedures used to collect groundwater samples, distilled water filtered through activated charcoal was used to make up "transport" and "transfer" blanks of "organic-free water." A transport blank is one filled at the EPA laboratory, taken into the field and shipped to the contract laboratory. A transfer blank is one filled at the EPA laboratory, taken into the field and then transferred with a clean stainless steel bailer into clean sample containers which are then shipped to the contract laboratory.

In addition, two clean 8-oz. wide mouth glass jars of the type used to collect soil samples were shipped to each of the contract laboratories to be rinsed with purified water so that the rinsate could be analyzed. Samples of the water used by the driller in drilling cable tool holes and of the pea gravel used to gravel pack the wells were also submitted for analysis.

All data from the contract laboratories were reviewed by the FIT for completeness and checked for correct procedures, instrument performance (gc/ms calibration), and recoveries (surrogate and matrix spike). Standard run checks and method blanks were checked against sample results and sample retention times; mass spectral data were reviewed. Checks on the calculations of the quantities of the various priority pollutants were made especially in the case where high values were reported. All of the information was documented on forms provided by the EPA Region X Laboratory (Appendix E).

Estimates of the quantities of the tentatively identified compounds (Appendix B), were made by the FIT chemist, as quantification of these compounds is not required under the contract specifications of the contract laboratories.

6.0 RESULTS AND DISCUSSION

6.1 Introduction

Because of the number of samples (170, with blanks), and the large number of parameters checked, it is impossible within the scope of this report to discuss them all. Selected samples, generally those most contaminated, are discussed, together with the blanks and the background well (Well 30).

The transport blank, which was supposedly organic-free water and went unopened from the EPA laboratory to the contract laboratory, shows four volatile organics at trace concentrations (<5 to 20 ug/l), and trichloroethane at 76 ug/l. These could have been in the water or from the container. The transfer blank, which consisted of the same water run through the bailer into a fresh container, showed no volatiles, but picked up 14.0 ug/l of zinc. It seems likely that the volatiles were in the water but that the zinc came off the bailer. For this reason, as a precaution, only levels of zinc above 500 ug/l will be regarded as clear indication of contamination in water. The rinsate from empty soil sample bottles showed insignificant levels of some metals, but had 88 ug/l of methylene chloride. Although this may be from the laboratory rather than the container, levels of methylene chloride in a soil sample of less than 500 ug/kg will be considered questionable evidence of contamination.

The pea gravel used by the driller in well construction showed traces of some metals and cyanide, but the potential impact on groundwater from the wells is negligable. The City of Kent water used by the driller was sampled and shows low levels of impurities. Only methylene chloride was significant (56 ug/l), and again may have come from the laboratory, but levels of methylene chloride of less than 250 ug/l should probably be regarded as suspect.

Conductivity and pH of groundwater can be useful measures of inorganic ions in the water and of the presence of acids or alkalies. These parameters were monitored for most of the on-site wells while they were being sampled (Appendix B). For conductivity the numbers range from 35 to >7500 micromhos. Uncontaminated groundwater at Lakewood, Washington, for comparison, ranged from 130-290 micromhos and any figure over 1000 would indicate pollution. The pH values ranged from 5.02 to 13.00, with the later being classifiable as a corrosive waste by RCRA criteria (cf. Federal Register, Vo. 45, No. 98, p. 33122, May 18, 1980).

Because of questions raised about organics, mainly the pesticide and base/neutral extractibles groups, being carried by sediment into groundwater samples, particular note should be taken of water samples from those wells installed where the soils were heavily contaminated with these organics. The water in these wells show very low or no levels of these compounds and is evidently largely free of contaminated sediment.

Because of the high levels of contamination encountered, generally only those instances where the soil exceeded 1000 mg/kg (ppm) dry weight of inorganics, or 1000 ug/kg (ppb) of organics are discussed. For the same reason only levels above 1000 ug/l or organics or inorganics in groundwater will be referred to, except when comparison with blanks or the background well (Well 30) is called for. These levels have no regulatory significance, but are used as indicators of gross contamination.

6.2 Summary of Results

In all, 87 priority pollutants were detected on or close to the site, 67 of them in quantifiable levels. Twelve other hazardous materials were noted, 11 at quantifiable levels. Twenty-one of those compounds are considered carcingens and 28 are considered suspected carcinogens.

One or more inorganic priority pollutant exceeded 1000 ppm in soil in 59 out of 130 samples (45%) and exceeded 1000 ug/l in groundwater in 28 out of 35 wells (80%). The percentage of samples in which organic priority pollutants exceeded 1000 ug/l in water or 1000 ug/kg in soil are 67.6% and 38.5%, respectively. Twenty out of 29 shallow wells and three out of five deep wells had one or more organic priority pollutants exceeding 1000 ug/l and nine out of 20 surface soil samples and 41 out of 110 borehole soil samples had one or more priority pollutants exceeding 1000 ug/kg.

Nineteen soil samples were classifiable as hazardous waste by RCRA definition, as were seven groundwater samples. Contaminant loading in soil and water both on-site and downgradient from it showed marked contamination in every case, ranging up to soil containing levels of priority pollutant metals of 9% and more.

It is clear that there has been widespread spillage, or leaking, or dumping of organic chemicals at this site, including material containing at least 36 priority pollutants in relatively high levels.

There is no doubt that the Western Processing site has created serious soil and groundwater contamination, and is contributng to air and surface water contamination.

6.3 Inorganics

The total dissolved solids (TDS) and chloride results (Appendix B) are a good general index of pollution. When compared to Well 30 as background, all the on-site or near site wells are at lease twice as high in chloride and TDS and range up to 1000 times greater in chloride at Well 10 and 28 and over 100 times greater in TDS in Wells 3, 5, 10, 11, 14, 16, 17 and 28.

Of the inorganics measured, aluminum, iron, manganese and boron are relatively common elements. Water from 21 wells exceeded 10,000 ug/l in one or more of these pollutants and ranged up to 510,000 ug/l, compared to levels of <200, 4600, 1200 and 1200 ug/l of these elements in the background well, Well 30 (Appendix B).

Of the priority pollutant metals (Appendix C), zinc is the most common. Twenty-one water samples exceeded 1000 ug/l, ranging up to 510,000 ug/l in Wells 18 and 28. For comparison Well 30 had 32 ug/l. Thirty-three soil samples exceeded 1000 mg/kg ranging up to 81,000 mg/kg in surface soil sample No. 5. It seems clear that zinc has been leaching out of the soil into the groundwater.

Other notably elevated metals analyses were: chromium in six wells, with levels up to 65,000 ug/l (in Well 14), copper in eight wells, with a high of 13,000 ug/l (in Well 5), nickel in eleven wells, with a high of 280,000 ug/l (in Well 10). Background levels are <10, <50 and 210 respectively, (in Well 30).

The two most toxic metals, after mercury, which does not appear to be a problem at this site, are cadmium and lead. These exceed 1000 ug/l in seven wells with lead at 3300 ug/l in Well 3 and cadmium at 60,000 ug/l in Well 10. For comparison the background well (Well 30), showed <1 ug/l cadmium and 21 ug/l lead. Lead in the soil exceeds 1000 mg/kg in 19 samples ranging up to 141,000 mg/kg near surface in Well 16. Cadmium in soils nowhere exceeds 420 mg/kg, but compared to lead a higher proportion of it seems to have leached into groundwater.

Cyanide was found at 35,000 ug/l in Well 5 but was not a widespread contaminant at high levels. Background level was <10 ug/l in Well 30.

EP Toxicity tests were performed on the most highly contaminated soils samples (Federal Register, Vol. 45, No. 98, p. 33127, May 18, 1980). This test measures the amount of toxic substance, in this case metal, that will leach out of a specific weight of waste under given conditons. Waste failing the test are hazardous wastes by definition under RCRA. Nineteen soil samples failed the test (Table 3), in six cases groundwater also failed this test. Lead was extracted from one sample at a level 154 times the maximum permitted for waste to be classified non-hazardous. Samples containing chromium were checked for hexavalent chrome, the more toxic form of the metal, but none was found.

6.4 Organics

Twenty-nine of the organic priority pollutants exceeded 1000 ug/kg (ppb) in soils or 1000 ug/l in water. Sixty-nine samples from 31 sites are affected.

In the "pesticide" group four different polychlorinated biphenyls (PCBs) were noted in one or more samples, but in other samples the PCBs were grouped as one analysis. Since these compounds adhere strongly to soils it is not suprising that they were not detected in groundwater. In all, 13 soil samples from six well sites, two samples from the berm and two surface soils show high PCB values, the highest being the sample from six to nine feet at Well 15 (19,600 ug/kg).

TABLE # 3

EP Toxicity Standard Exceedance

(multiple of standard)

Station	Chromium *	Cadmium *	Lead *
Soils			
Well #3 (6 ft)		1.6	
Well #3 (12 ft)		1.2	
Well #10 (6 ft)		1.4	
Well #15 (9 ft)		1.2	
Well #16 (3 ft)			154
Well #16 (6 ft)			3.8
Well #16 (9 ft)	1.9		1.22
Well #20 (3 ft)		4.2	5.4
Well #21 (3 ft)		9.6	2.2
Well #21 (6 ft)		1.3	
Well #23 (6 ft)			4.2
Berm #3			1.62
Berm #7			1.36
Soil Sample #3			3.8
Soil Sample #4			1.4
Soil Sample #5		12	3.6
Soil Sample #6			70.
Soil Sample #7			44.
Soil Sample #12			7.
Water Samples			
Well #10 (shallow - 15')	3.4	40	-
Well #11 (shallow - 15')	-	4.8	-
Well #11 (deep - 30')	-	3.9	-
Well #14 (shallow - 15')	13	12	-
Well #17 (shallow - 15')	6.4	4.5	-
Well #28 (shallow - 15')	1.22	5.6	-

* Standard for Chromium = 5,000 ug/l
Standard for Cadmium = 1,000 ug/l
Standard for Lead = 5,000 ug/l

In one soil sample (Well 6, 0-3ft) aldrin and dieldrin were found (2,860 ug/kg and 3340 ug/kg respectively). This is the only sample containing markedly elevated pesticide levels.

Of the base/neutral extractibles 16 were noted at levels greater than 1000 ug/kg (1 ppm). All 18 samples affected were soils, the most contaminated of which was surface soil sample #8 with approximately 5.1% by weight of priority pollutants, including 2.0% of phenanthrene and 1.6% pyrene.

The sample results in excess of 1000 ug/kg (1 ppm) are listed in Table 4.

TABLE 4 - BASE/NEUTRAL EXTRACTIBLES

Compound	Number of Samples	Highest Value Found
Acenaphthene	3	5090 ppm
Hexachloroethane	1	1.8 ppm
Phthalates (as a group)	14	860 ppm
Benzo-[a]-anthracene	1	200 ppm
Fluoranthene	7	234 ppm
Naphthalene	3	5.2 ppm
Benzo-k-fluoranthene	1	130 ppm
Chrysene	4	1210 ppm
Anthracene	1	1.6 ppm
Fluorene	4	8600 ppm
Phenanthrene	9	20,000 ppm
Pyrene	8	16,000 ppm

The acid extractibles are all phenolics and of these six were found at levels above 1000 ug/l or 1000 ug/kg. The most important compound was phenol itself which was found in 12 wells and 13 soil samples. The highest concentration was in Well 27 which had a suprising 4,100,000 ug/l. Of the soil samples the most contaminated, (12-15 feet,Well 22), contained 65,000 ug/kg.

To summarize the highest levels of phenolics: pentachlorophenol was found in two soil samples including a surface sample with 17,000 ug/kg; 2,4-dichlorophenol was found in five soil samples the highest level found being 7900 ug/kg between three to six feet in Well 10; 2,4-d-methylphenol was in two wells, the higher level being 1100 ug/l in Well 12, and in six soil samples including a surface soil containing 11,000 ug/kg; 2-nitrophenol was found off-site in Well 27 in the extraordinary concentration of 1,300 mg/l; and lastly, 4-nitrophenol was found in Well 15 at 3200 ug/l.

After the base/neutral extractibles, the volatiles group is the most heavily represented. Nine different priority pollutants occur at levels greater than 1000 ug/l or 1000 ug/kg. The highest level of any volatile found was 720,000 ug/l of methylene choride in Well 15. Methylene chloride is also found at high levels in 12 other wells and nine soil samples. Trichloroethene is even more widespread, being found in 18 wells and eight soil samples. The most contaminated well is Well 15 again, with 210,000 ug/l. The most contaminated soil is also from Well 15 at three to six feet (580,000 ug/kg).

Toluene is found in seven wells within the range of 1000-22,000 ug/l with the highest level in Well 17. Of the six soils samples in the >1000 ug/kg range the highest is also from Well 17 at three to six feet, and registered 394,000 ug/kg.

Chloroform is found in that same sample at 18,000 ug/kg, and in five groundwater samples, with the highest reaching 27,000 ug/l (Well 15). This well has the highest level for 1,1,1-trichloroethane at 340,000 ug/l while three others have high values also. Not suprisingly, of two soil samples contaminated with the same compound the higher is from Well 15 at three to six feet, (174,000 ug/kg). 1,1-dichloroethane is found at high levels only in two water samples, the higher again being from Well 15 (33,000 ug/l). Trans-1,2-dichloroethene is also found at high levels only in water. Of five wells affected the highest is Well 21 (390,000 ug/l). Lastly, ethylbenzene is found at significant concentrations in three soil samples, the worst being from Well 17 at three to six feet (37,000 ug/kg).

Besides these priority pollutants, which were selected as indicators of industrial pollution as the result of a consent agreement requiring the EPA to create a list of the most common such materials, there are many other hazardous substances. Twelve of these materials, acetone, benzoic acid, benzyl alcohol, 2-butanone, dibenzofuran, 2-hexanone, 2methyl napththalene, 2-methylphenol, 4-methylphenol, styrene, 2,4,5trichlorophenol and o-xylene, were noted; one or more occuring in 69 soil samples and 23 groundwater samples (Appendix B). For example, acetone occurs in soil in levels up to 17,000 ug/kg (Well 17), and in groundwater in the same well is found at 130,000 ug/l. 2-butanone is also found in the soil in Well 17 at up to 580,000 ug/kg and in the water at 460,000 ug/l.

Numerous other compounds were identified with varying degrees of assurance, and their levels estimated by the FIT (see Tentatively Identified Compounds, Appendix B). For example, 2-oxazolidinone, 2-(2-hydroxypropyl)-5-methyl occurs quite commonly, reaching a level of 60,000 ug/kg (Well 9, Soil six to nine feet).

6.5 Carcinogens

A number of known and suspected carcinogens were detected on and around the Western Processing site. The 21 known carcinogens found, are underlined on Table 5. The 28 suspected carcinogens, including two not on the priority pollutant list, are underlined on Table 6.

6.6 Total Contaminant Levels

To give a better idea of the overall impact of the site, tables were constructed showing the total load of contaminants in selected water and soil samples. Analyses from six on-site wells, one background well, (Well 30), and one downgradient well, (Well 28, Fig. 2),

TABLE 5

Known Carcinogens *

on EPA Priority Pollutant List

Arsenic
Beryllium
Cadmium
Nickel
Chromium

Gamma BHC (Lindane)
PCB-1016
PCB-1221
PCB-1232
PCB-1242

PCB-1248
PCB-1254
PCB-1260
Toxaphene
Benzo(a)anthracene

Benxo(b)fluoranthene
Benzo(a)pyrene
TCDD
Benzidine
N-Nitrosodimethylamine
N-Nitrosodi-N-propylamine

Acrylonitrile
Benzene
Bis (Chloromethyl) Ether
Carbon Tetrachloride
Chloroform

1,2-Dichloroethane
Vinyl Chloride

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* National Toxicology Program.

TABLE 6

Suspected Carcinogens *

on EPA Priority Pollutant List

Alpha BHC
Chlordane
Dieldrin
Heptachlor
Heptachlor Epoxide

Phenanthrene
Anthracene
1,2,5,6-Dibenzanthracene (perylene)
Benzo(ghi)perylene
Naphthalene

2-Chloronaphthalene
Acenaphthene
Acenaphthylene
Fluorene
Flouranthene (Benzo(k)fluorene)

Benzo(k)fluoranthene
Chrysene
Pyrene
Indeno (1,2,3-CD)pyrene
3,3-Dichlorobenzidine

Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
N-Nitrosodiphenylamine
Bis(2-Chloroethyl)Ether

2,4,6-Trichlorophenol
P-Chloro-M-Cresol
4,6-Dinitro-O-Cresol
Chlorobenzene

2-Chloroethyl Vinyl Ether
1,1,2,2-Tetrachloroethane
1,2-Trans-Dichloroethylene

Non PP
Hazardous Materials (partial list)

Styrene
Dibenzofuran

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* Soderman, J.V., R. J. Lewis and R.L. Tatken

were tabulated (Table 7). Thirty-two priority pollutants were found in the on-site wells in measurable quantities. Twenty priority pollutants and five hazardous materials were found in the downgradient well, all of which were found on-site. Only four priority pollutants were found in a significant level in the background well. Total contaminant levels (both priority pollutant and others) are listed in Table 7, together with chloride, total dissolved solids and pH (where measured).

Priority pollutants are usually measured in parts per billion in water samples. Some are thought to have effects on human health even at these levels in drinking water. Carcinogens are generally thought to have no threshold below which they have no effect. Of the on-site priority pollutants in Table 7 eight are considered carcinogens and four are suspected carcinogens.

Total contaminants in the selected wells ranged from 53,323 ug/l to 1,359,982 ug/l (averaging 709,393 ug/l). The background well, in contrast, has a total contaminant load of 956 ug/l. Interestingly, the well most highly contaminated with priority pollutants is Well 27, downgradient from the site. Because of the high levels of phenol and 2-nitrophenol the priority pollutant loading is 5,683,500 ug/l.

The analytical data for the soil samples shows total contaminant levels even higher than for water, particularly in the case of the inorganics. Selected soil samples (Table 4) shows lead up to 8.4% in one sample, zinc up to 8.1%, and several organics above the 1% level. Total contaminant loads for these samples range from 0.02% to an astonishing 9.93% (Table 8).

The distribution of hazardous material in the soils and groundwater shows some interesting patterns. Total priority pollutant metals in surface soils and average levels in borehole soils exceed 1000 ppm over most of the site (Fig. 6). Only at the northwest corner of the site around Wells 1, 2, 4, 6, 7, 8, 11 and 12, and at the south end of the site around Wells 24, 25 and 26 are lower levels encountered. This accords quite well with the distribution of total priority pollutant metals in shallow groundwater (Fig. 7). This is in excess of 100 mg/l off the northeast corner of the site in Wells 19 and 29, and in the middle of the site around Wells 10, 11, 14, 16, 17, 18, 27 and 28. Levels are suprisingly low below the south part of the site and also in Well 16. The top 15 feet of soils in this well average an astonishing 4.6% lead, the highest in any well, but the lead level in the groundwater is only 470 ug/l.

The sum of all the volatile priority pollutants in soils from each well suggests that there are at least two major spill locations on-site, at Wells 15 and 17 (Fig. 8). The distribution of volatiles in the groundwater suggests that there may well be several more spills, upstream of Wells 21, 27, and possibly 14, for example (Fig. 9).

The sum of the total priority pollutant acid extractibles (phenols) found in soil samples, does not yield a clear picture (Fig. 10). Levels of from 2 to 102 ppm are scattered over the site from the south end north to Well 10. The groundwater picture suggests a major source may be the lagoons along the west side of the site, near Well 27. Other sources may be the "reaction pond" and burial sites or spills near Wells 17, and 5 (Fig. 11).

Distribution of priority pollutant base/neutral extractibles in soils extends south from Well 11 almost to the south end of the site. Concentrations in the surface soils range from non-detected to 5.8% (Fig. 12), within this area. Evidently these compounds are relatively strongly adsorbed on soils, because only very low levels are found in groundwater.

TABLE 7
DATA SUMMARY FOR SELECTED WELLS *

Carcinogin Code **	Parameters	Well #5 (Shallow)	Well #15 (Shallow)	Well #17 (Shallow)	Well #17 (Deep)	Well #21 (Shallow)	Well #22 (Deep)	Well #28 (Shallow)	Well #3 (Shallow
	Dissolved Metals	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)	(ug/l)
0 0	Chromium	400	170	32,000	680	180	22	6,100	-
	Copper	13,000	3,400	7,200	240	-	-	590	-
0 0	Nickel	25,000	360	26,000	3,200	220	280	77,000	21
	Zinc	(650)	(260)	360,000	160,000	(330)	(30,000)	510,000	(3
0 0	Arsenic	-	-	32	-	-	32	25	-
	Antimony	-	-	-	-	-	26	-	-
	Selenium	-	-	-	-	-	4.1	-	-
	Mercury	0.28	1.1	0.83	0.83	0.28	46	-	0
0 0	Cadmium	160	(11)	4,500	(800)	-	(77)	5,600	-
	Lead	-	-	1,600	210	-	-	6.5	2
	Silver	-	-	-	-	-	-	45	
	Miscellaneous								
	Cyanide	35,000	(1,200)	(92)	-	-	(36)	920	-
	Acid Extractibles								
0	2,4,6 Trichlorophenol	8,800	-	-	-	-	-	-	-
	2,4 Dimethylphenol	520	-	-	-	-	-	-	-
	2-Nitrophenol	-	-	-	300	190	-	-	-
	4-Nitrophenol	-	3,200	-	-	-	-	-	-
	Pentachlorophenol	1,400	-	-	-	-	-	-	-
	Phenol	270,000	4,900	91,000	380	10,000	-	4,000	-
	2,4 Dichlorophenol	-	-	-	-	-	-	220	-
	Base-Neutrals								
	1,2-Dichlorobenzene	-	160	-	-	-	-	-	-
	Bis(2-Ethylhexyl) Phthalate	-	-	-	-	-	-	-	
	Isophorone	-	-	-	-	-	-	540	-
	Volatiles								
0 0	Benzene	77	-	2,200	-	-	-	-	-
0 0	1,2-Dichloroethane	-	16,000	-	-	-	-	-	-
	1,1,1-Trichloroethane	2,900	340,000	1,700	-	-	-	100	-
	1,1-Dichloroethane	320	33,000	-	-	-	-	-	-
0 0	Chloroform	130	27,000	12,000	130	-	7,600	-	-
	1,1 Dichloroethene	87	-	-	-	-	-	-	-
0	Trans-1,2-Dichloroethene	-	6	-	-	38,000	-	-	-
	Ethylbenzene	32	-	-	-	-	-	-	-
	Methylene Chloride	23,000	320,000	42,000	1,200	100,000	-	5,400	-
	Fluorotrichloromethane	-	-	420	-	-	-	-	-
	Tetrachloroethene	37	-	-	-	-	-	50	-
	Toluene	4,100	-	22,000	430	-	-	110	-
	Trichloroethene	16,000	210,000	42,000	830	170,000	17,000	840	-
0 0	Vinylchloride	-	-	-	-	360	-	-	-
	Pesticides								
	Aldrin	-	-	-	-	-	-	3.3	-
	Dieldrin	-	-	-	-	-	-	3.6	-
	Heptachlor	-	-	-	-	-	-	3.29	-
	Non-Priority Pollutant Hazardous Wastes								
	2-Methylphenol	980	-	-	-	1,500	-	8,000	-
	4-Methylphenol	3,000	320	64,000	320	4,900	-	600	-
	2,4,5-Trichlorophenol	8,800	-	-	-	-	-	-	-
	Acetone	13,000	-	130,000	12,000	-	-	2,820	-
	2-Butanone	6,100	-	460,000	28,000	-	-	2,500	-
0	Styrene	290	-	-	-	-	-	-	-
	O-Xylene	102	-	-	102	-	-	-	-
	Benzoic Acid	-	-	-	-	-	-	1,200	-
	Indicator Parameters	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/
	Chloride	1,737	1,670	3,394	782	4,202	2,202	5,447	
	Total Dissolved Solids	20,356	9,406	19,652	4,636	4,626	6,128	18,564	
	PH	13	No Data	6.26	5.02	No Data	5.96	No Data	No D

* See Appendix for complete tabulation

** 0 0 = Confirmed carcinogin (Listed on NTP list of "88" - 1982)

0 = Highly suspect based on frequency of positive results in lab animals/mutagenic screening, etc.

TABLE 8

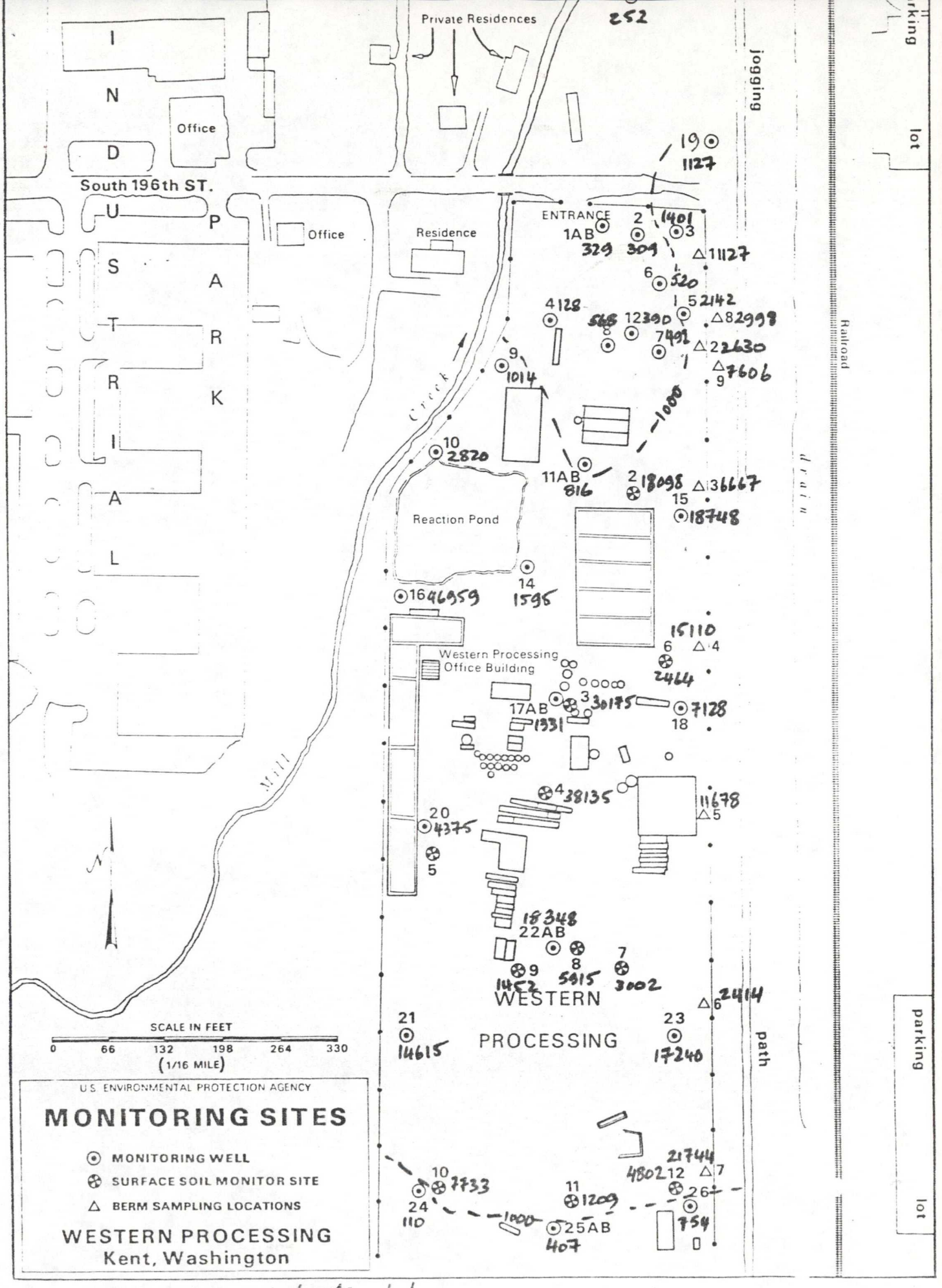
DATA SUMMARY FOR SELECTED SOIL SAMPLES*

Parameter	WELL 8 - 3' SAMPLE	WELL 10 - 9' SAMPLE	WELL 11 - 12' SAMPLE	WELL 15 - 6' SAMPLE	WELL 16 - 3' SAMPLE	WELL 17 - 9' SAMPLE	WELL 17 - 12' SAMPLE	WELL 21 - 3' SAMPLE	WELL 22 - 9' SAMPLE
Metals	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)
Chromium	6,240	148,000	100,000	7,600,000	19,000	140,000	150,000	370,000	3,900,000
Copper	26,000	280,000	39,000	5,100,000	150,000	66,000	45,000	360,000	335,000
Nickel	5,600	148,000	43,000	400,000	(13,000)	40,000	(20,000)	17,000	340,000
Zinc	76,000	75,000	410,000	6,800,000	210,000	1,900,000	1,000,000	40,500,000	11,200,000
Silver	-	-	-	-	-	-	-	-	-
Arsenic	6,300	(2,200)	-	3,800	102,000	(4,400)	(2,000)	6,500	-
Antimony	-	-	-	-	-	-	-	(6,700)	109,000
Selenium	-	-	-	1,800	-	-	-	-	-
Mercury	-	-	-	-	(30)	-	-	-	-
Cadmium	330	25,000	2,100	170,000	20,000	13,600	6,000	226,000	412,000
Lead	21,000	18,000	280,000	1,900,000	84,000,000	81,000	39,000	6,460,000	24,600,000
Miscellaneous									
Cyanide	16,100	-	32,000	35,600	-	-	(1,700)	-	179,000
Acid Extractables									
2,4, Dichlorophenol	-	3,200	-	-	-	-	-	1,400	-
2,4, Dimethylphenol	-	-	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	-
Phenol	-	27,000	-	-	-	12,000	-	-	-
Pesticides									
Aldrin	1,665	-	-	-	-	-	-	-	-
Chlordane	1,345	-	-	-	-	-	-	-	-
Heptachlor	2,930	-	-	-	-	-	-	-	-
G-BHC (Lindane)	-	-	-	-	-	-	-	-	-
PCB - 1016	-	-	-	3,160	-	-	-	-	-
PCB - 1248	-	-	-	-	-	-	-	-	-
PCB - 1254	-	-	-	-	-	-	-	-	-
PCB - 1260	-	-	-	1,110	-	-	-	-	-
Base Neutrals									
Acenaphthene	-	-	8,700	-	-	-	-	-	-
1,4 Dichlorobenzene	-	-	-	965,000	-	-	-	-	-
Fluoranthene	-	-	7,300	-	-	-	-	7,700	-
Naphthalene	-	-	5,200	-	-	-	-	-	-
Bis(2-Ethylhexyl) Phthalate	-	-	29,900	-	-	-	-	3,300	410,000
Benzyl Butyl Phthalate	-	-	9,100	-	-	-	-	-	-
Di-n-Butyl Phthalate	-	-	-	-	-	-	-	-	-
Benzo(a)anthracene	-	-	-	-	-	-	-	8,000	-
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	-	-	-	-
Chrysene	-	-	-	-	-	-	-	2,500	-
Anthracene	-	-	-	-	-	-	-	1,600	-
Fluorene	-	-	16,900	-	-	-	-	-	-
Phenanthrene	-	-	62,400	-	-	-	-	7,000	-
Pyrene	-	-	11,000	-	-	-	-	1,400	-
Volatiles									
Tetrachloroethylene	-	-	81	72,000	-	-	36	-	-
Toluene	-	-	83	48,000	-	280,000	19,900	-	43
Trichloroethylene	-	-	312	380,000	-	350,000	25,300	-	-
Benzene	-	-	-	-	-	-	199.5	-	-
1,1,1-Trichloroethane	-	-	18.2	174,000	-	16,000	332.5	-	-
1,1-Dichloroethane	-	-	-	-	-	-	17.3	-	-
Chloroform	-	-	-	-	-	18,000	505	-	-
Ethylbenzene	-	-	143	-	-	24,000	1,596	-	28
Methylene Chloride	-	22	91	30,000	116	89,000	1,191	21	30
Fluorotrichloromethane	-	-	-	-	26	-	36	-	-
Non-Priority Pollutant Hazardous Wastes									
2-methylphenol	-	-	-	-	-	-	-	-	-
4-methylphenol	-	-	-	-	-	5,600	-	-	-
Acetone	-	1,000	-	-	-	-	17,000,000	-	-
2-butanone	-	1,310	-	-	-	380,000	92,000	-	-
O-xylene	-	-	-	-	-	24,000	1,100	-	42
2-Methylnaphthalene	-	-	-	-	-	2,300	-	-	-
Dibenzofuran	-	-	-	-	-	-	-	-	-
Total Contaminant	162,700	670,132	1,087,280	23,107,070	84,514,172	3,816,900	18,408,919	48,081,821	41,725,143
% of Total Sample	0.02%	0.07%	0.11%	2.3%	8.45%	0.36%	1.84%	4.81%	4.17%

Parameter	BERM #4	BERM #7	BERM #8	BERM #9	SURFACE SAMPLE #3	SURFACE SAMPLE #8	SURFACE SAMPLE #10	SURFACE SAMPLE #11	SURFACE SAMPLE #12
Metals	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)	(ug/Kg)
Chromium	250,000	180,000	1,600,000	5,300,000	190,000	60,000	55,000	39,000	450,[illegible]
Copper	190,000	250,000	590,000	890,000	580,000	220,000	880,000	260,000	960,[illegible]
Nickel	240,000	160,000	24,000	34,000	57,000	49,000	64,000	(10,000)	76,[illegible]
Zinc	13,300,000	17,[illegible]	540,600	1,190,000	81,000,000	4,100,000	820,000	760,000	2,080,[illegible]
Silver	-	-	-	-	6,100	-	-	-	-
Arsenic	-	(2,400)	-	-	17,000	8,500	(2,000)	-	14,[illegible]
Antimony	-	-	-	-	(6,000)	-	(9,500)	-	14,[illegible]
Selenium	(1,000)	(900)	-	-	-	-	-	-	-
Mercury	(40)	(60)	140	-	-	-	-	-	-
Cadmium	49,000	71,000	14,000	22,000	420,000	16,000	4,300	1,700	10,[illegible]
Lead	1,090,000	5,100,000	230,000	110,000	17,000,000	870,000	5,900,000	190,000	1,300,[illegible]
Miscellaneous									
Cyanide	-		-	-	-	-	(1,200)	13,000	15,000
Acid Extractables									
2,4, Dichlorophenol	-	-	-	-	-	-	-	-	-
2,4, Dimethylphenol	-	-	-	-	-	11,000	-	1,070	-
Pentachlorophenol	-	-	-	-	-	17,000	-	-	3,300
Phenol	-	-	-	-	-	19,000	-	1,170	2,600
Pesticides									
Aldrin	-	-	-	-	-	-	-	-	-
Chlordane	-	-	-	-	145	-	-	-	-
Heptachlor	-	-	-	-	-	-	-	-	-
G-BHC (Lindane)	-	-	-	-	34	-	-	-	-
PCB - 1016	-	-	-	-	-	-	-	-	-
PCB - 1248	-	-	-	2,046	-	-	-	-	-
PCB - 1254	-	-	-	-	-	-	-	3,300	2,012
PCB - 1260	-	-	2,030	-	-	-	-	-	-
Base Neutrals									
Acenaphthene	-	-	-	-	-	5,090,000	-	-	4,700
1,4 Dichlorobenzene	-	-	-	-	-	-	-	-	-
Fluoranthene	-	-	-	-	-	15,000	59,000	234,000	16,000
Naphthalene	-	-	-	-	-	6,200,000	120,000	627,000	18,000
Bis(2-Ethylhexyl) Phthalate	-	-	-	-	-	-	500,000	860,000	14,000
Benzyl Butyl Phthalate	-	-	-	-	-	-	-	-	-
Di-n-Butyl Phthalate	-	-	-	-	-	-	-	-	2,600
Benzo(a)anthracene	-	-	-	-	-	884,000	-	76,000	4,400
Benzo(b)fluoranthene	-	-	-	-	-	200,000	-	-	-
Benzo(k)fluoranthene	-	-	-	-	-	130,000	-	-	-
Chrysene	-	-	-	-	-	1,210,000	-	85,000	5,100
Anthracene	-	-	-	-	-	-	-	-	-
Fluorene	-	-	-	-	-	8,600,000	-	62,000	5,100
Phenanthrene	-	-	-	-	-	20,000,000	190,000	765,000	-
Pyrene	-	-	-	-	-	16,000,000	65,000	283,000	18,000
Volatiles									
Tetrachloroethylene	-	-	-	-	-	-	-	-	-
Toluene	-	-	-	-	-	-	-	-	-
Trichloroethylene	37	-	(21)	-	-	-	-	-	-
Benzene	-	-	-	-	-	-	-	-	-
1,1,1-Trichloroethane	-	-	-	-	-	-	-	-	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-
Chloroform	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	13	-	-	-	-	-
Methylene Chloride	25.52	-	-	-	14.9	91	-	63	-
Fluorotrichloromethane	-	-	-	-	-	-	-	25	-
Non-Priority Pollutant Hazardous Wastes									
2-methylphenol	-	-	-	-	-	1,200	-	760	-
4-methylphenol	-	-	-	-	-	64,000	-	3,000	4,600
Acetone	-	-	-	-	-	-	-	-	-
2-butanone	-	-	-	-	-	-	-	-	-
O-xylene	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	-	-	-	-	-	290,000	6,000	36,000	15,000
Dibenzofuran	-	-	-	-	-	250,000	-	-	4,000
Total Contaminant	15,110,103	21,744,360	3,000,191	7,608,059	99,276,294	64,910,791	9,676,000	42 510.00	4,941,412
% of Total Sample	1.51%	2.17%	0.30%	0.76%	9.93%	6.49%	0.97%	0.43%	0.49%

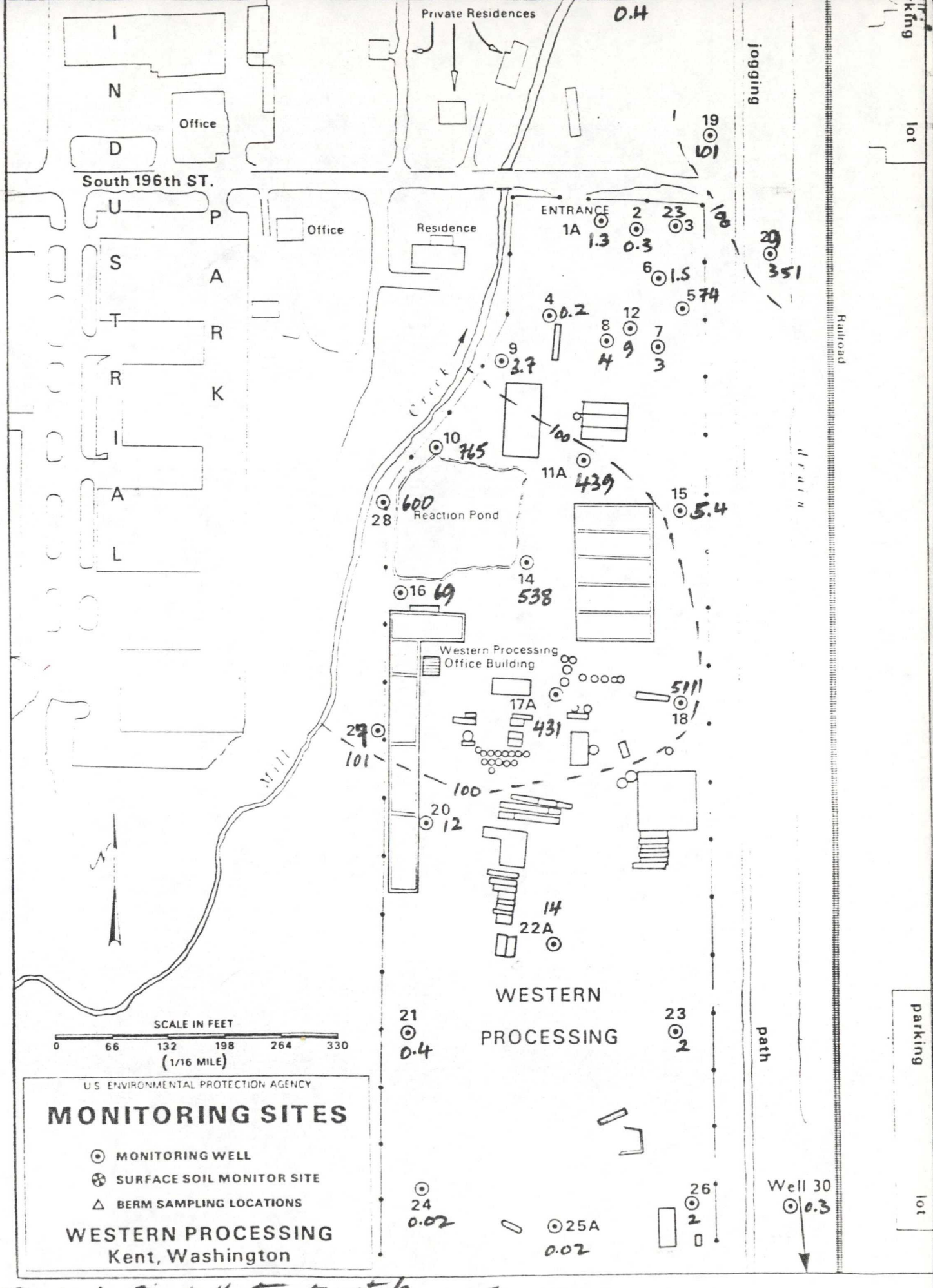
*[illegible]ndix for complete tabulation.

[illegible] Confirmed carcinogens (listed on NTP list of "88" - 1982)
[illegible] based on frequency of positive results in
[illegible] pollutant screening, etc.



~~Average~~ Total priority pollutant metals in soils (PPM)

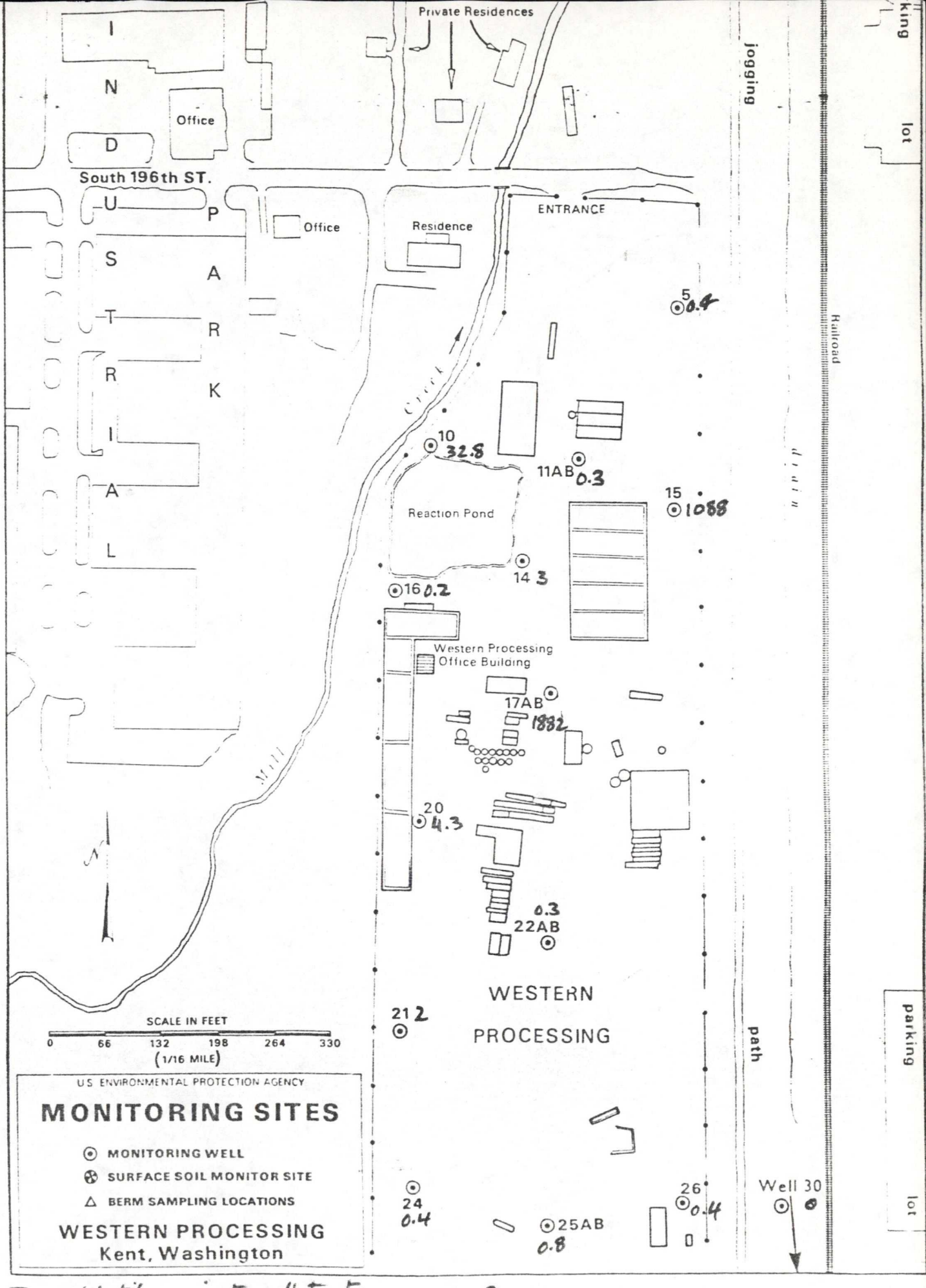
Figure 3 6



Total priority pollutant metals ~~in~~ (in shallow) groundwater, (mg/ℓ); ~~Shallow wells.~~

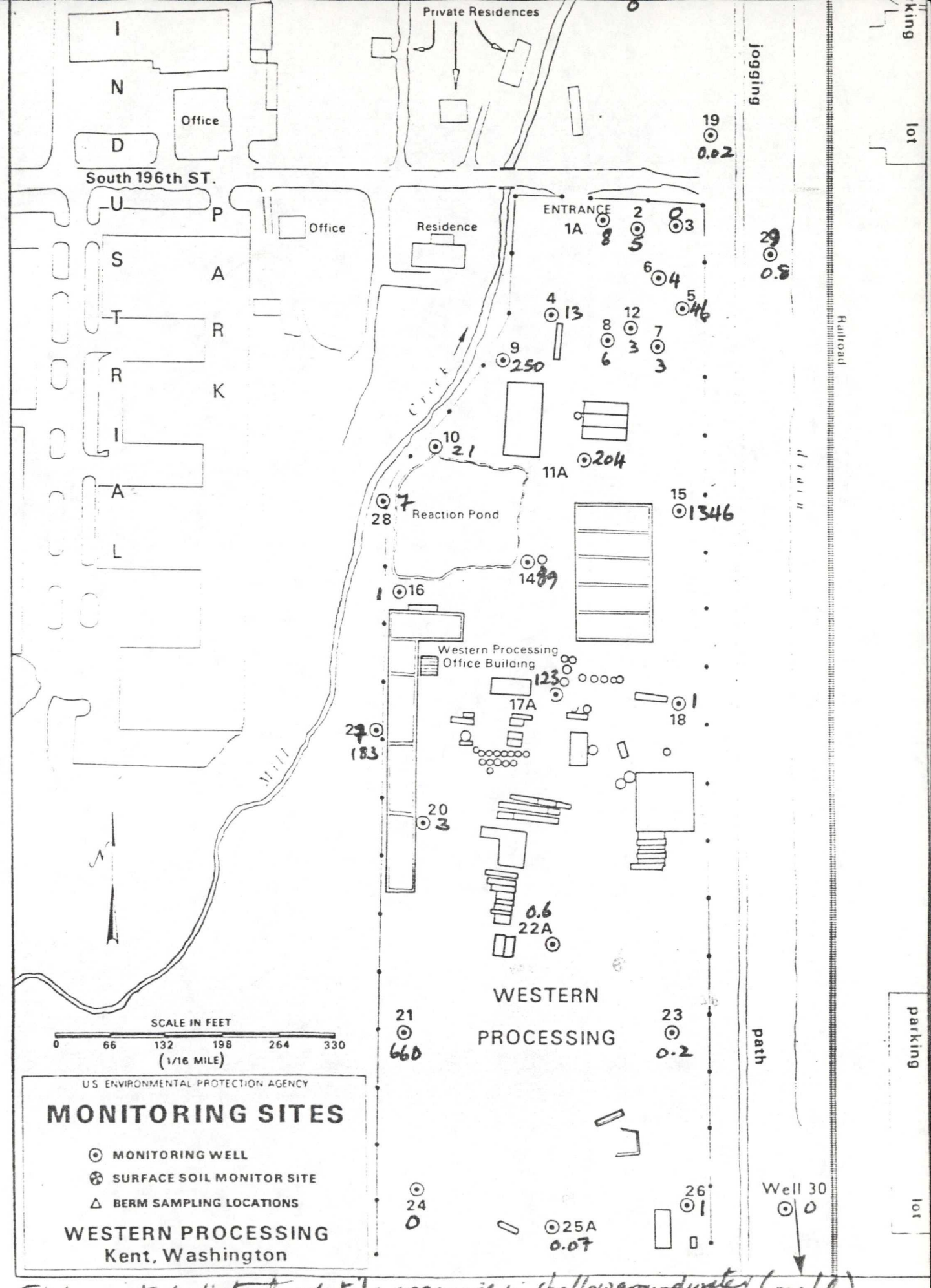
Figure 7

30



Total Volatile priority pollutants in soils (ppm).

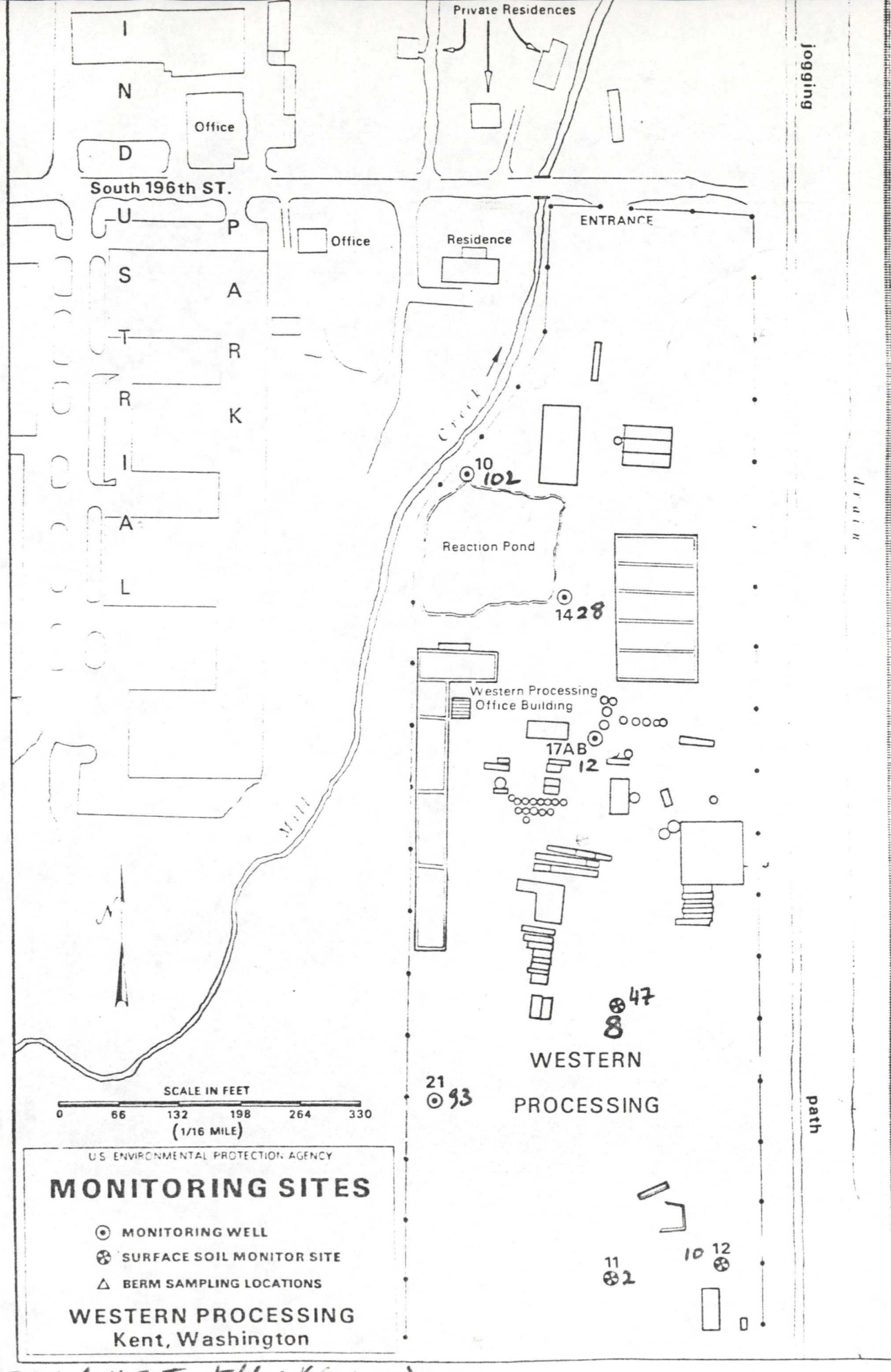
Figure 8



Total priority pollutant volatile organics in shallow groundwater (mg/L)

organics (mg/L). Shallow wells.

Figure 8



Total Priority pollutant ~~Total~~ Acid Extractibles (~~ppm~~ ppm), in Soils. ppm

Figure 3

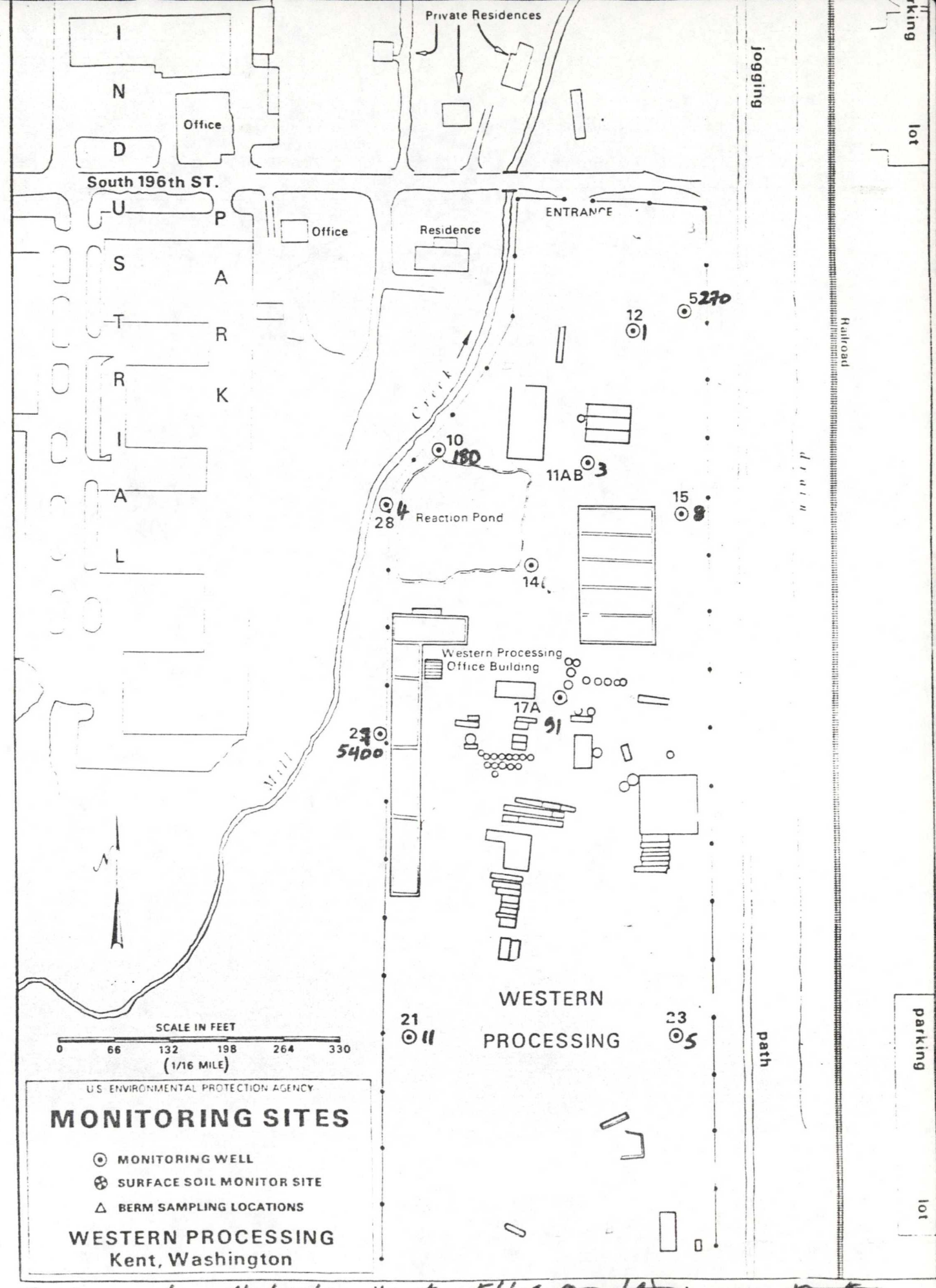


Figure 3 II

Total priority pollutant and extractibles [redacted] in shallow groundwater [redacted] (mg/l)

34

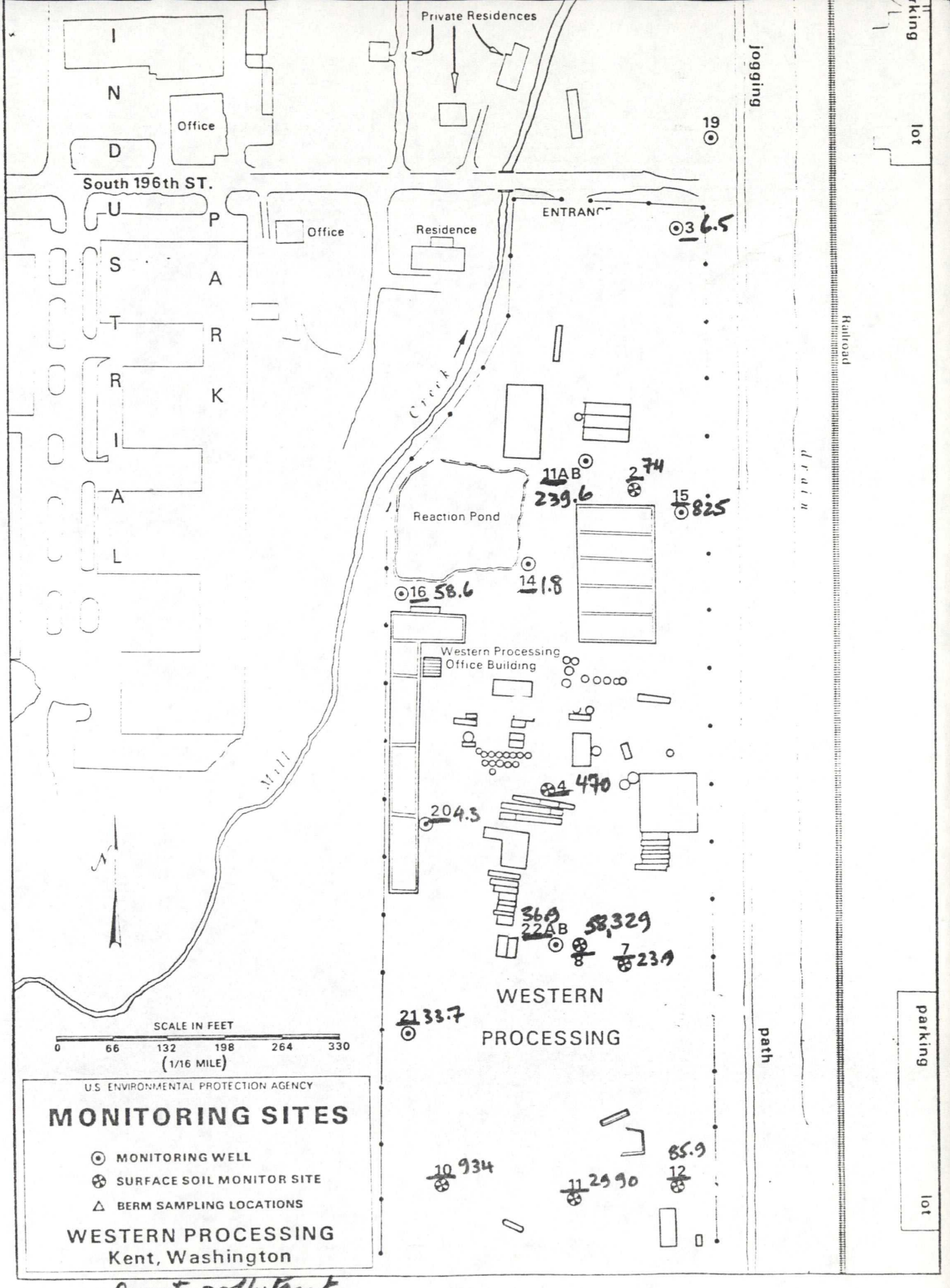


Figure # 12

Total Priority pollutant Base/Neutral Extractables in Soils. (ppm)

35

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